THE INSTITUTE SPOKESMAN

PUBLISHED BY THE
NATIONAL LUBRICATING GREASE INSTITUTE

VOLUME X • NUMBER X • DECEMBER 1946

New N.L.G.I. Technical Bulletin

The National Lubricating Grease Institute has just issued a new Technical Bulletin entitled: "Determination of the Flow Characteristics of Lubricating Greases."

This Technical Bulletin covers in detail the development of a Pressure-Viscosimeter suited for determining the apparent viscosities of lubricating greases over a considerable range of rates of shear.

The viscosimeter instrument and its method of operation are described and additional chapters in the Bulletin deal with the significance and application of grease viscosity data.

The Pressure-Viscosimeter, although developed primarily for determination of the flow characteristics of lubricating greases, is also suited for viscosity measurement of extremely viscous oils or for measurements at very low temperatures, wherein other types of viscosimeter instruments are not satisfactory. Chapters in the Bulletin give further information on this application.

Copies of the N.L.G.I. Bulletin on "Determination of the Flow Characteristics of Lubricating Grease" may be procured from Carl E. Bolte, Executive Secretary, National Lubricating Grease Institute, 1116 Land Bank Building, Kansas City 6, Missouri, at $1.00 each.

Six New Board Members Elected

At the Annual Business Meeting of the National Lubricating Grease Institute attended by the Active Members present at the 14th annual convention on Monday afternoon, September the 30th, 1946, the following six Directors proposed by the Nominating Committee were unanimously elected for a three-year period:

Mr. W. G. Clark	Mr. H. P. Hobart
Pure Oil Co.	Gulf Oil Co.
Chicago, Ill.	Pittsburgh, Pa.
Mr. J. R. Corbett	Mr. H. A. Mayor
Cato Oil and Grease Co.	Southwest Grease & Oil Co.
Oklahoma City, Okla.	Wichita, Kans.
Mr. C. W. Georgi	Mr. G. L. Neely
Enterprise Oil Co.	Standard Oil Co. of Calif.
Buffalo, N. Y.	San Francisco, Calif.

The following Directors will serve for the two remaining years of their three-year term for which they were elected at the annual meeting in 1945:

Mr. J. R. Battenfeld	Mr. E. V. Moncrieff
Battenfeld Grease & Oil Co.	Swan-Finch Oil Co.
Kansas City, Mo.	New York, N. Y.
Mr. M. R. Bower	Mr. W. H. Saunders, Jr.
Standard Oil Co. of Ohio	Intern'l Lubricant Corp.
Cleveland, Ohio	New Orleans, La.
Mr. F. C. Kerns	Mr. B. G. Symon
The Texas Co.	Shell Oil Co., Inc.
New York, N. Y.	New York, N. Y.

The following Directors will serve for the one remaining year in their three-year term for which they were elected at the annual meeting in 1945:

Mr. G. E. Merkle	Mr. W. H. Oldacre
Fiske Bros. Refining Co.	D. A. Stuart Oil Co., Ltd.
Toledo, Ohio	Chicago, Ill.
Mr. C. B. Karns	Mr. B. C. Voshell
Standard Oil Co. of Pa.	Socony-Vacuum Oil Co.
Pittsburgh, Pa.	New York, N. Y.
Mr. Harry Cooper	Mr. L. C. Welch
Sinclair Refining Co.	Standard Oil Co. of Ind.
New York, N. Y.	Chicago, Ill.

These eighteen men constitute the Board of Directors of the National Lubricating Grease Institute for 1945-46.

The INSTITUTE SPOKESMAN

Published monthly by

THE NATIONAL LUBRICATING GREASE INSTITUTE

CARL E. BOLTE ..... *Editor*

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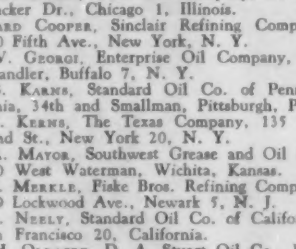

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TRIBUTE TO GEORGE W. MILLER . . .

For ten years George W. Miller, Presi- t of the Battenfeld Grease and Oil rporation of New York at Buffalo ved as Executive Secretary of the Na- nal Lubricating Grease Institute. It s a "labor of love," one of those "extra- ricular jobs" for which Mr. Miller ceived no pay and to which he gave lless hours of time, thought, and en- y, all of it after his regular office rs were over or on Saturday afternoon Sunday. Mr. Miller edited "The In- ute Spokesman," official publication the National Lubricating Grease In- ute and saw it grow from a very nble beginning in March of 1937 with irculation of only 200 copies to its sent position of being the one publi- on devoted exclusively to the lubricat- grease industry. It is accepted uni- ally as the authority in that field, ering not only the United States and nada, but going to England, Australia, th Africa, and the Middle East.

Mr. Miller carried on the correspond- ce that came to the Institute's national dquarters, arranged for the Annual etings, the meetings of the Board of rectors, did all the other tasks which a part of the operation and function- of a great industry association such the N.L.G.I. It is certainly no exag- ation, in fact it is a conservative state- nt, to say that without George Miller his interest in the Institute, his great on for its future and his willingness make a personal sacrifice the National bricating Grease Institute would not py its present position and standing.

With the expanded program and ag- ssive activities which included the ap- ntment of a full-time Executive Sec- ary by the 1945-46 Board of Directors e followed automatically Mr. Miller's gnation. This was presented in writ- to the Board of Directors at its July eting in Hershey, Pennsylvania, and accepted with expressions of appre- tion, tribute, and praise for the mar- ous job which Mr. Miller had done ing the past ten years.

Unanimously and with enthusiasm the ard immediately elected Mr. Miller Re- ding Secretary of the National Lubri- ing Grease Institute, a position au- rized by the Constitution and By-laws, never previously filled. In this acity Mr. Miller's intimate knowledge the Institute's affairs, his advice and nsel will be available to the officers members of the Board.

Reprinted here in full is Mr. Miller's

George W. Miller

letter of resignation and President Carl W. Georgi's reply.

July 1, 1946

To the Board of Directors
National Lubricating Grease Institute
Gentlemen:

I hereby respectfully tender my resignation as Executive Secretary of the National Lubricating Grease Institute to become effective on this date.

It has been a pleasure to work for and with the Institute and I wish to take this opportunity to express my appreciation of the fine cooperation given me throughout the ten years I have held this office. The only regret I have is that I was unable to give more time to Institute affairs.

At this time I would also like to extend to Mr. Bolte, our new Executive Secretary, my fullest cooperation and assistance at all times.

Very truly yours,
(Signed) Geo. W. Miller

July 31, 1946

Mr. Geo. W. Miller
Battenfeld Grease and Oil Corporation
North Tonawanda, New York
Dear George:

It is with a rather mixed feeling of regret and pleasure that I accept, on behalf of the Board of Directors, your resignation as Secretary of the National Lubricating Grease Institute. The feeling of regret is occasioned by this ending your long association with the Institute as Secretary, and the many memories this association brings to mind. The feeling of pleasure is occasioned by the fact that we now have a permanent full-time Secretary in Carl E. Bolte, who will relieve you of many of your past N.L.G.I. duties and efforts, and who will have the time to develop and expand the N.L.G.I. along the lines we have discussed on so many occasions.

Speaking on behalf of the Board of Directors and the entire N.L.G.I. membership, I want to express our deep appreciation of all the work and time you have so generously contributed in handling the many duties of the Secretary and in editing the "Institute Spokesman." The work you have done has really constituted a full-time job and I know everyone appreciates the tremendous amount of time you have donated during the past ten years. The growth and success of the Institute over this period has been due, in very large measure, to your efforts. We all owe you a vote of gratitude.

Sincerely,
National Lubricating Grease Institute
(Signed) Carl W. Georgi
President

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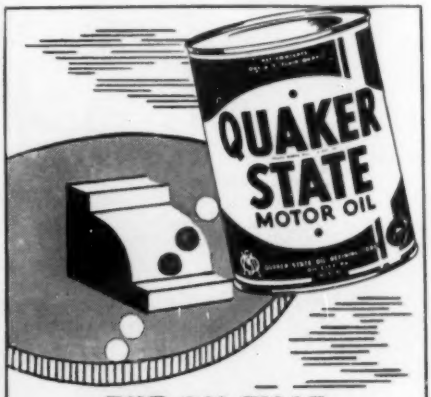

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Continuous Process for ALUMINUM GREASES

by H. G. Houlton, M. Sutton, and H. W. Bevarly

This paper was presented by Mr. H. G. Houlton before the recent 14th Annual N. L. G. I. Convention in Chicago, Ill.

Aluminum grease, up to the present, generally has been made batchwise. Oil and aluminum soap were mixed and heated to about 275° to 310° F. in an open kettle of about 4,000 lb. capacity, until the soap went into solution. Hot grease was then poured into pans for cooling and gelling. The pans held about 30 to 100 lb. They were stacked 10 to 20 high in tiers. The cooling rate was generally controlled and took about 12 hours. After the grease gel had set, it was dumped from the pans into a hopper; and then pumped through some type of grease "worker" into package. A worker was used to produce a grease of fairly stable consistency. Such workers consisted of multiple screens, vacuum centrifuges, mills, and similar equipment.

An element in the batch process which was sometimes a problem was the nonuniform consistency of the grease when cooling and gelling took place simultaneously in pans. The grease around the edges of the pan cooled rapidly and formed a hard gel, while at the center of the pan the grease cooled slowly and formed a soft gel. The worker was used to produce a fairly stable consistency by breaking the false set of the gel and by thoroughly intermixing the various consistencies resulting from pan cooling. Such factors were eliminated and did not appear as problems when the continuous process was employed.

This paper presents plant data covering a continuous process manufacturing aluminum grease at the rate of 1,500 to 2,000 lb. per hour. The process is radically different from batch operation in many respects.

Fig. 1 shows a flow sheet of the continuous process. An oil-and-soap slurry is made under about 22-26 in. of vacuum

H. G. Houlton

The slurry is pumped at approximately 1,500 lb. per hour through a heating Votator to dissolve the soap; through a cooling Votator to cool the grease; and

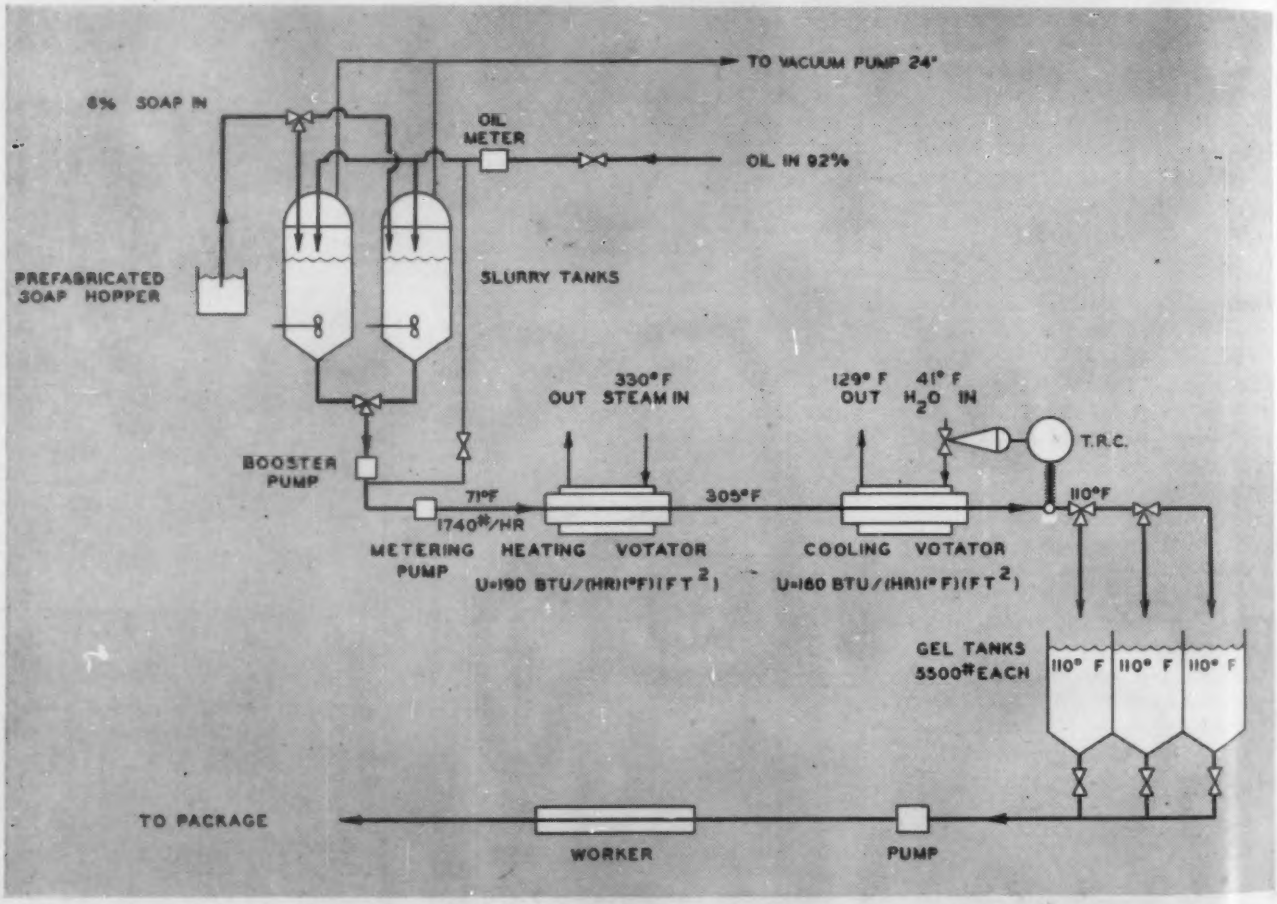

Fig. 1—Flow sheet of the continuous process.

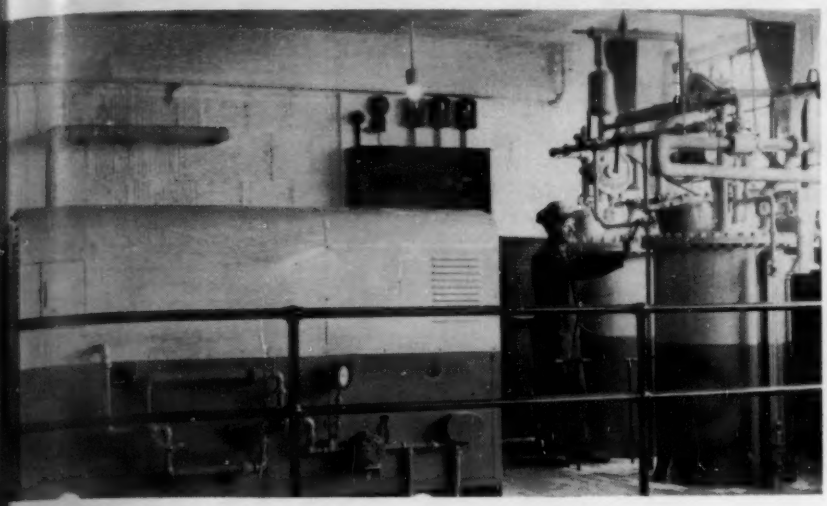

Fig. 2—Plant installation showing oil-soap slurry tanks.

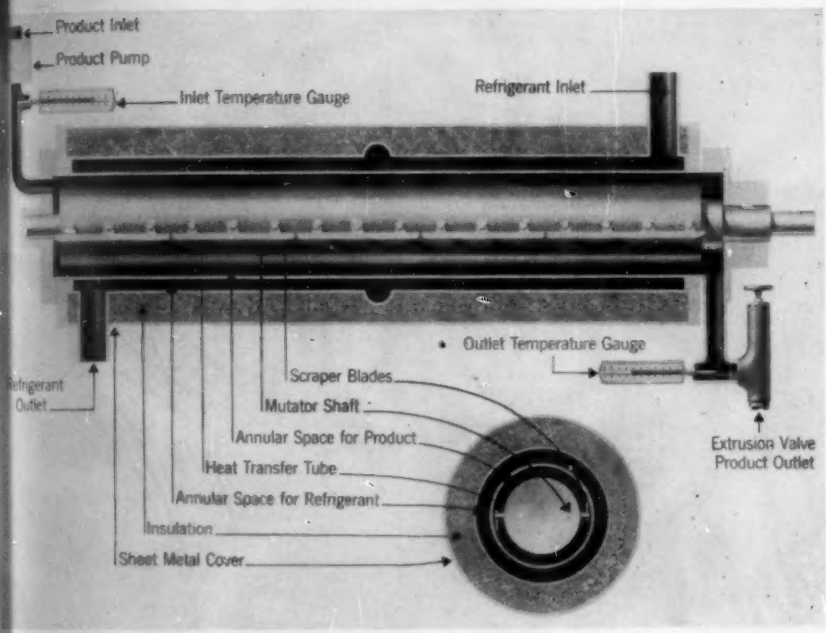

Fig. 3—Cutaway view showing Votator construction.

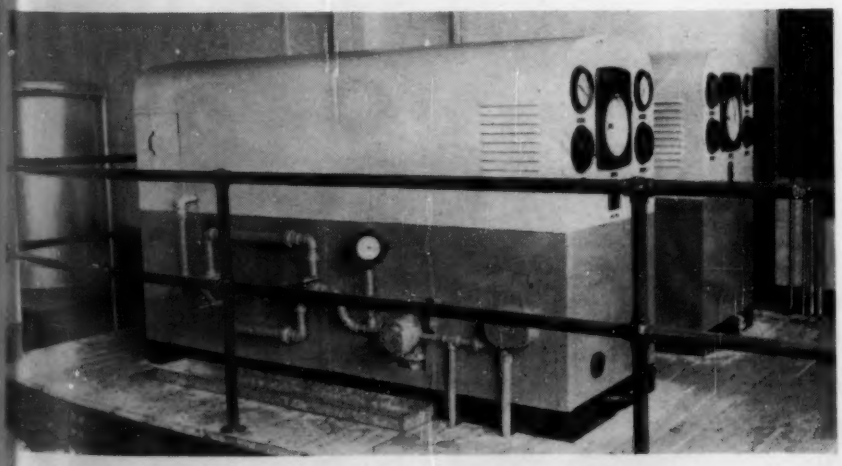

Fig. 4—Plant installation showing heating and cooling Votators.

then, into insulated gel tanks holding about 5,500 lb. each where the grease was gelled isothermally. The uniformly gelled grease is then pumped from the gel tank through a worker to break down the false set of the grease to a constant consistency. Since the grease is uniform in consistency in the gel tanks, intermixing is not necessary.

Slurry Preparation

It was found that slurries of soap and oil made in open tanks incorporated a considerable amount of air. Most of the air was entrained with the soap. With light-viscosity oils a slurry could be made in open tanks and pumped continuously through a deaerator to the heating Votator. However, with heavy oils the mixture became too difficult to deaerate in this manner. Consequently, soap and oil slurries were prepared under vacuum in order to prevent air entrainment.

For continuous operation two vacuum slurry tanks are provided. This allows time for charging one tank while pumping from the other. Metered quantities of oil are pumped into the vacuum tank, deaerated before soap addition, and kept free from air while mixing. Weighed quantities of soap are drawn into the tank by vacuum. Thus deaerated soap

Continued on page 7

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Aluminum Greases

Continued from page 5

contacts deaerated oil. The tanks are fitted with an agitator, single-stage steam jet ejector, soap trap, low-level alarm, and liquid-level indicator.

The oil-and-soap slurry is drawn from the vacuum slurry tank by means of a booster pump and delivered to the suction of the Votator feed pump at constant head pressure. The booster pump is fitted with a spring-loaded bypass valve to return back the excess slurry to the slurry tank. Fig. 2 shows two of these vacuum slurry tanks.

Heating—The heating unit used is a steam-jacketed Votator, a cross-section of which is shown in Fig. 3. In the space between the cover and jacket wall is insulation. Between the jacket wall and the heat-transfer tube is the heat-transfer medium (which, in this case, is steam). Between the heat-transfer wall and the rapidly rotating shaft is the narrow annular space for the slurry. The shaft is equipped with blades which scrape the slurry from the inside surface of the heat transfer wall and violently intermix this heated layer of slurry with the main body of slurry in the narrow annular space of the Votator, thus uniformly heating and thoroughly mixing the oil and soap.

An instrument panel is provided on the control end of the unit. It is fitted with a thermometer to indicate product inlet temperature; a recording thermometer to record product outlet temperature; a gage to indicate steam pressure; a gage to indicate pump discharge pressure; and a signal light to indicate low level on slurry tanks.

The slurry of oil and soap is pumped through the narrow product space, while being subjected to violent agitation, in from 10 to 180 seconds, and the temperature raised in this period of time to approximately 300° F. in order to dissolve the soap in the oil.

Cooling—The hot grease then flows continuously through a cooling Votator

Continued on following page

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of similar design and cools to a predetermined critical gelling temperature in about the same time, 10 to 180 seconds. This Votator is equipped with recording controller in order accurately to control the temperature of the grease going to the gelling tanks. The cooling step is one of the most important and critical steps of the process. Fig. 4 shows the heating and cooling Votators. Table 1 gives a summary of the heat-transfer operations and shows an over-all coefficient of 190 for heating and 160 for cooling.

TABLE 1—HEAT DATA ON CONTINUOUS GREASE MANUFACTURE

	Grease	Power	Steam	Water
Heating stage:				
Lb./hr.	1,740	.....	.....	.....
Inlet, °F.	71	.....	†330	.....
Outlet, °F.	305	.....	.....	.....
B.t.u./hr.	245,000	12,000	*233,000	.....
Specific heat, Cp	0.6	.....	.....	.....
Over-all coefficient U	190	.....	.....	.....
Cooling stage:				
Lb./hr.	1,740	.....	.....	2,700
Inlet, °F.	305	.....	.....	41
Outlet, °F.	110	.....	.....	129
B.t.u./hr.	204,000	32,000	.....	235,000
Specific heat, Cp	0.6	.....	.....	1
Overall coefficient U	.....	.....	.....	157
Film coefficient h	420	.....	.....	*317
Velocity ft./sec.	.....	.....	.....	1.12
Re	.....	.....	.....	11,300

*Calculated. †85 per cent quality.

Gelling—The grease then flows to insulated gelling tanks (Fig. 5), where it is allowed to gel Isothermally so that all the grease has a uniform consistency in the gel tank. Two or more gel tanks are provided. The cooling step and the gelling step are thus separated to allow accurate control of each individual operation. After the gel sets, the grease is pumped through a worker and into package.

Operation

Scrap grease is held to a negligible amount. When starting the equipment, the grease is pumped through the heater and cooler and back to the feed pump. When equilibrium conditions are reached and operating temperatures correct, the grease is allowed to go to the gel tank. If some scrap grease is formed it is pumped from a small hopper to the feed pump or to the slurry tank and thus reprocessed.

Fig. 5—Plant view showing cooled aluminum steara grease flowing into insulated gel tanks.

Processed Variables—It was found th the source and refinery treatment of th

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, and the type and manufacture of p markedly affected operating condi-ns, and finished product. However, se conditions were constant for a given and soap.

Table 2 summarizes pertinent data re-ing to the following graphs. Fig. 6 ws a typical cooling curve. To obtain se curves thermos-bottle samples of ease were taken from the cooling Vo-ter at various temperatures indicated the graph. These samples are allowed cool to room temperature and pene-tion and bleed values obtained accord-g to standard methods. For more ac-rate work the samples must be allowed gel isothermally in ovens and then led for penetration tests.

The penetration curves of Fig. 6 show t grease, of this particular formula, about the same final consistency as g as the cooling temperature is 180° or above. This temperature is the nsition temperature, which may be de-ed as that temperature above which s grease will not gel when stored iso-rmally. As the temperature of this ease leaving the cooling Votator is wered below 180° F., the finished gel rapidly increases in strength and thus provides better yields. This occurs down to approximately 140° F., which is the critical temperature. At this temperature good stability with maximum yield is obtained. Temperatures greater than the critical temperature produce softer greases which show no oven bleed; temperatures lower than this produce softer greases which show appreciable oven bleeds. From this it was determined that in order to produce the hardest grease one should work as closely to the critical temperature as possible; that to insure a bleed free grease it was well to operate slightly above it, and that the gelling operation should be separated from the cooling operation. In carrying out the process in this manner, soap savings over batch coolings have amounted to approximately 20 per cent. Moreover, the finished packaged product breaks down little in the A.S.T.M. grease worker; i. e., usually less than 30 penetration points when worked with 60 strokes.

Though these cooling curves do not apply to pan cooling, they do help to better understand some of the problems of batch manufacture. In order to avoid gelling part of the batch-made grease at too low an average gelling temperature and thus produce an unstable product, the main temperature of the grease in the kettle, if similar to grease of the type shown in Fig. 6, would need to be approximately 200° F. or more; and, in addition, the rate of cooling would need to be slow and controlled. In pan cooling, where cooling and gelling take place simultaneously, various hardnesses of grease will be formed in the pan. The grease on the outside will cool quickly and gel to a hard consistency. This grease corresponds roughly to that shown in the lower part of the 140°-180° F. range. Its hardness will, therefore, be proportional to the average temperature of gelling during the cooling period. At the center of the pan just the opposite effect takes place.

Surrounded by an insulating film of grease the center part of the grease in the pan is slow to gel; it has an average gel temperature high in the 140°-180° F. range, and consequently forms a soft stable gel exhibiting no syneresis. Oft-times in pans where cooling becomes sufficiently fast that the grease will have

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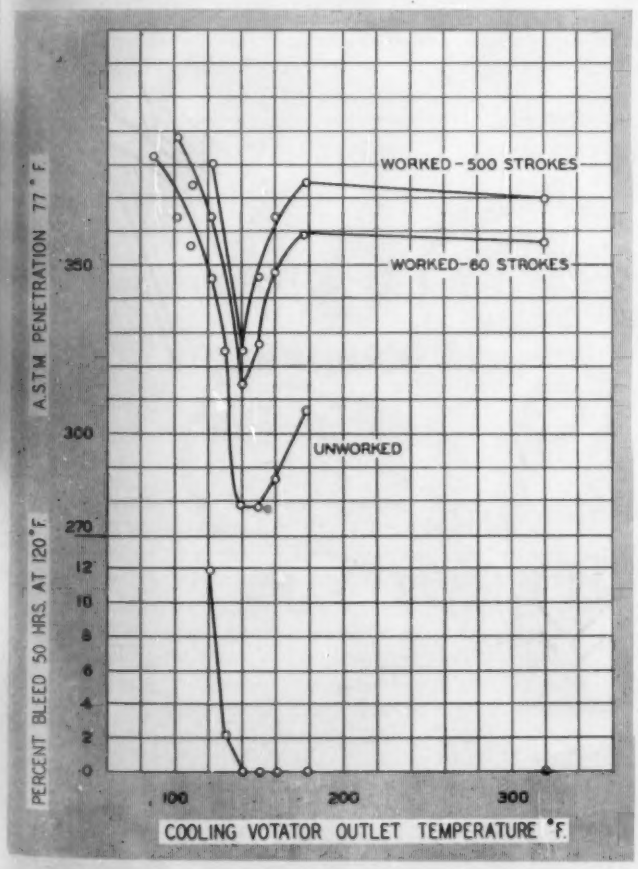
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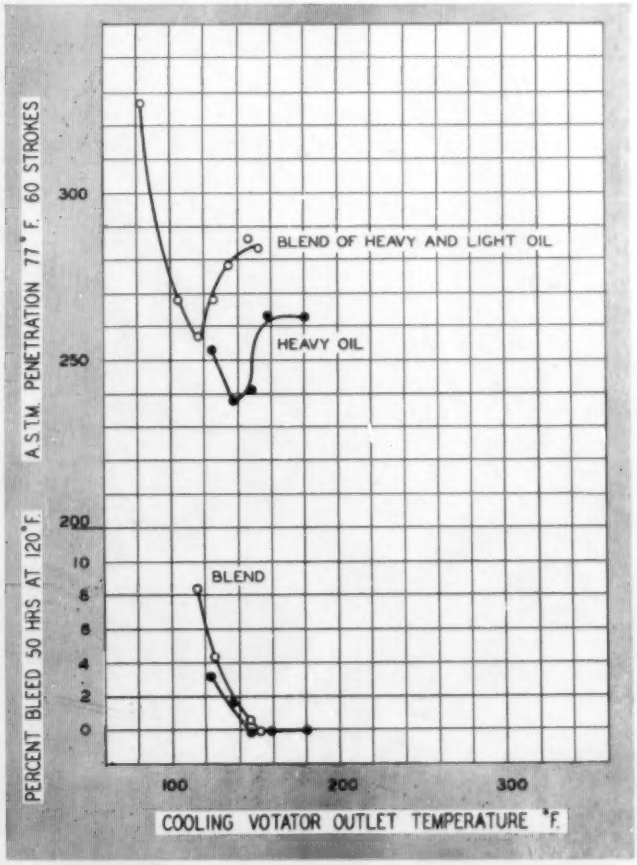
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BLEND
A.S.T.M. PENETRATION 77° F. 60 STROKES
PERCENT BLEED 50 HRS AT 120°F.
COOLING VOTATOR OUTLET TEMPERATURE °F.

Fig. 6—(Left) Typical cooling curve showing A.S.T.M. penetration and oven bleeds as function of Votator cooling temperature, for grease made from 94 per cent Mid-Continent oil and 6 per cent aluminum stearate soap. Fig. 7—(Right) Cooling curves showing effect of blending low-viscosity paraffinic oil with high-viscosity Coastal bright-stock oil. Blending resulted in lower yield, lower critical temperature, increased sensitivity to syneresis.

The Votator Division

of

The Girdler Corporation

announces its appointment as licensing agent

for the continuous grease processes

of the

Standard Oil Development Company

●

THE GIRDLER CORPORATION

VOTATOR DIVISION

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luminum Greases

ntinued from page 9

average gelling temperature below 0° F., syneresis results. The grease ill then show a high oven bleed or may tually show free oil on the surface of e grease. Pans of such grease may in dition show large fractures and cracks which the free or extruded oil gathers. he pan method thus leads to a finished oduct which is blended from all ranges consistencies and stabilities that this rticular grease system can give. This of course, brought about by simul-neously gelling and cooling.

Achieving Uniform Product

From the above discussion it is obvious at simultaneous cooling and gelling ads to a product difficult to control d of varying properties. Therefore, if ese two functions, cooling and gelling, uld be separated a most uniform and rd grease could be produced. Because the narrow width at the upper part of e vortex in the curves for critical tem-rature, it is exceptionally easy to mask d pass by the existing aluminum while oling. And commercially, when the uminum grease was made in pans, the ixtures of various hardnesses were so complete that such a minimum was not found. In the Votator, on the other hand, a high film coefficient was obtained on the grease side which resulted in a smaller temperature gradient through the grease film. In turn this caused the average temperature of the grease film and the main body of the grease to come quite close together. This, therefore, resulted in a very uniform and controlled product. Furthermore, it allowed cooling to take place without gelling since even with this equipment the gel time was appreciably longer than the cooling period of about 2 minutes. Below the critical temperature, grease will start to gel in the Votator; that is, the soap fibers will have started to grow. These fibers in turn, are then broken by the agitation and an unstable product, as measured by bleed, results.

The other tests on proper gelling conditions are generally visual in character

Continued on following page

TABLE 2—OIL, SOAP, AND GREASE DATA FOR COOLING CURVES

	Fig. 6		Fig. 7	Fig. 8		
Formula:	Oil heavy		Oil blend	Soap A	Soap B	Soap C
Per cent oil	94	92	92	94	94	94
Per cent soap	6	8	8	6	6	6
Oil analysis:						
Source	Mid-Cont.	Coastal	Coastal & Paraf.		Mid-Cont.	
Refinery treatment	Cyl. stock	Br. St.	Br. St. Dist.		Cyl. stock	
S.S.U. viscosity	126 at 210° F.	3940 at 100° F.	545 at 100° F.		126 at 210° F.	
Viscosity index	63	55.5	70		63	
A.P.I. gravity	23.7	21.2	23.6		23.7	
Avg. molecular wt	550	517	417		550	
Soap analysis:						
Moisture, %	0.6	.....	1.0	0.4	0.98	0.6
Total fatty acid, %	89.2	.....	93.9	91.6	89.4	89.2
Free fatty acid, %	8.2	.....	5.2	7.4	7.6	8.2
Ignition residue, %	9.4	.....	9.7	9.8	11.6	9.4
Water soluble res., %	0.8	.....	1.0	0.8	1.3	0.8
Water insol. res., %	8.6	.....	8.8	8.9	10.3	8.6
Titer °C	52	.....	52	47.4	51.2	52.0
Iodine value	5	.....	5	6.0	3.5	5.0
Saponification value	192	.....	190	214.0	199	192
Grease data:						
Trans. temp., * °F	175	160	160	170	170	170
Crit. temp.,* °F	140	140	115	145	140	135
Penetration min.†	315	238	258	292	318	328

*Approximate. †60 strokes.

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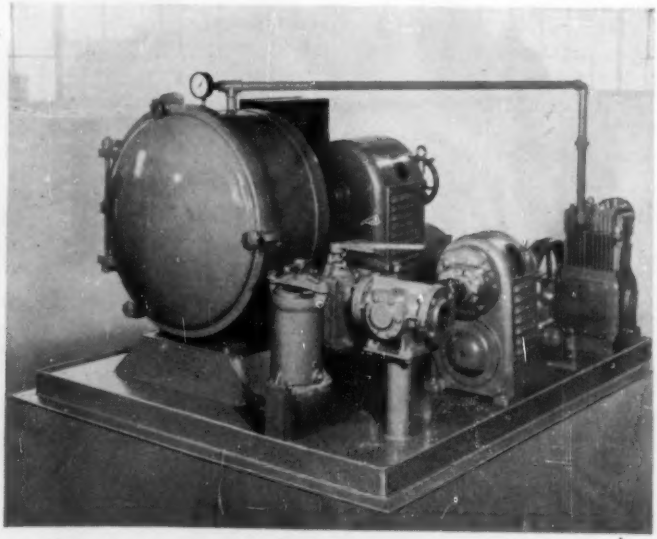

Grease Homogenizer, showing feed pumps, strainers and vacuum pump.

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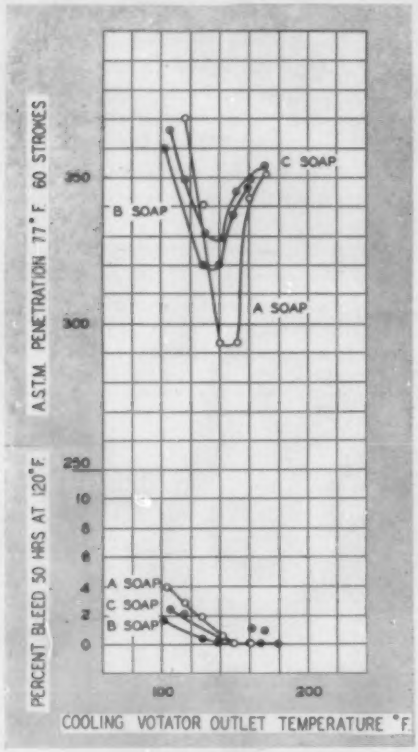

Fig. 8—Cooling curve comparing three commercial aluminum stearate soaps.

and involve an experience factor. These consist of (a) surface sheen, (b) brightness, (c) transparency, and (d) float. The first three of these are self explanatory. Float, however, is defined as the rough appearance of a thin spread film of grease when it is examined in reflected light. Float cannot be felt and apparently has little to do with the serviceability of the grease, but has much to do with the sales appeal of the product. Improper gelling is the main cause of float and probably results in different grease structures of different hardness which are then worked together but not completely incorporated in the main body of the grease. Impurities in the original soap may also contribute to float. By careful control of gelling float is avoided and a bright, transparent grease results.

Fig. 9—Curves showing power load, pressure drop, and cooling curve methods of establishing critical temperatures.

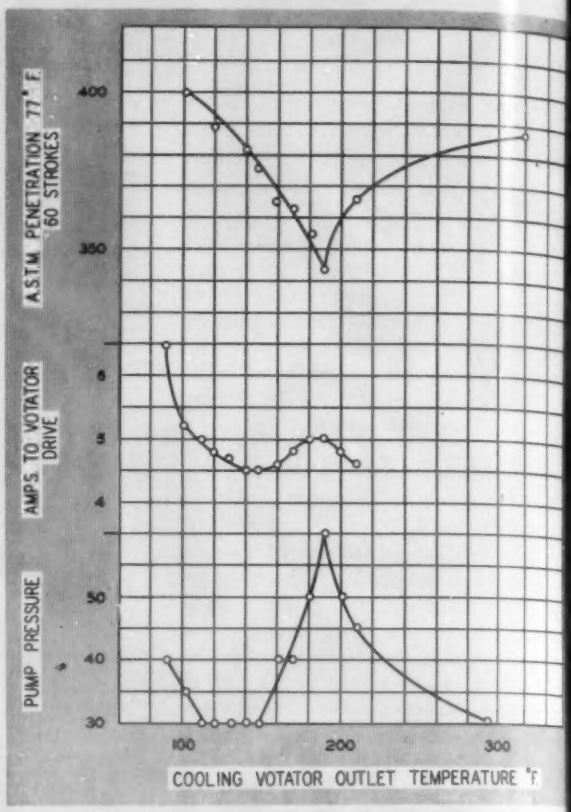

Fig. 7 shows the effect of blending a heavy oil with a light oil with relation to the transition and critical temperatures of these two oils. The addition of light oil lowers the critical temperature, and yield; and increases the tendency of the grease to bleed.

Fig. 8 shows the properties of grease made from three commercial aluminum stearate soaps. Soap A formed a substantially harder grease than either Soap B or C. At the same time Soap C which give the poorest yield also was somewhat more prone to bleed. Table 1 shows that the molecular weight of the fat in the soap was the major variable in the analysis of these soaps.

Fig. 9 shows the correspondence of pumping pressure and Votator power loads in relation to critical temperature. All three of these methods, cooling curves, power loads, and pressure drop, can be used for the determination of the critical temperature for a given formation.

The advantages of the continuous process reside not only in closer control, but also in higher grease yield, conservation of floor space, and labor savings. In one plant, soap saving alone amortiz the processing equipment in one year.

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